Performance Study of Space-based Infrared Bracewell Interferometers

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The Darwin and TPF-I missions will be able to detect and to study the atmosphere of distant worlds similar to the Earth. Flying these space-based interferometers will however be an extraordinary technological challenge and a first step could be taken by a smaller mission. Several proposals have already been made in this context, using the simplest nulling scheme composed of 2 beam collectors, i.e., the original Bracewell interferometer. These projects, viz. Pegase and the Fourier-Kelvin Space Interferometer (FKSI), show very good perspectives for the detection and characterisation of hot extra-solar giant planets, i.e., Jupiter-size planets orbiting close to their parent star. In this paper, we build on these concepts and try to optimise a Bracewell interferometer for the detection of Earth-like planets. Our work is based on the CNES study for a formation flying infrared interferometer (Pegase), whose specifications have been tuned to fit the new goal (Earth-like planets). The major challenge is to mitigate the influence of the exo-zodiacal emission which cannot be suppressed by internal modulation as in the case of Darwin. We assess the capabilities of split-pupil configurations with phase chopping and OPD modulation techniques, which are good candidates for such a mitigation. Beyond the capabilities of a modified Pegase, this paper gives an estimation of the performance to be expected for a space-based Bracewell infrared interferometer for the detection of extra-solar planets.